Claims:

1. A gas delivery assembly, comprising:

a covering member comprising an expanding channel at a central portion of the covering member and comprising a bottom surface extending from the expanding channel to a peripheral portion of the covering member; and

one or more gas conduits coupled to the expanding channel, wherein the one or more gas conduits are positioned at an angle from a center of the expanding channel.

2. The gas delivery assembly of claim 1, wherein the one or more gas conduits are disposed normal to a longitudinal axis of the expanding channel.

3. The gas delivery assembly of claim 1, wherein the one or more gas conduits are disposed at an angle to a longitudinal axis of the expanding channel.

4. The gas delivery assembly of claim 3, wherein the one or more gas conduits are angled downwardly.

5. The gas delivery assembly of claim 3, wherein the one or more gas conduits are angled upwardly.

6. The gas delivery assembly of claim 1, wherein the one or more gas conduits are disposed along the length of the expanding channel.

7. The gas delivery assembly of claim 1, wherein the one or more gas conduits are disposed at the same length around the expanding channel.

8. The gas delivery assembly of claim 7, wherein the one or more gas conduits are equally spaced out around a perimeter of the expanding channel.

9. The gas delivery assembly of claim 7, wherein the one or more gas conduits are disposed at an upper portion of the expanding channel.

10. The gas delivery assembly of claim 1, wherein the one or more gas conduits are positioned toward the same circular direction.

11. The gas delivery assembly of claim 1, wherein the expanding channel comprises a tapered surface extending from the central portion of the covering member.

12. The gas delivery assembly of claim 11, wherein the tapered surface of the expanding channel comprises a surface selected from the group consisting of a straight surface, a concave surface, a convex surface, or combinations thereof.

13. The gas delivery assembly of claim 11, wherein the expanding channel is shaped as a truncated cone.

14. The gas delivery assembly of claim 1, wherein the expanding channel comprises an upper portion and a lower portion, the upper portion having a smaller inner diameter than the lower portion.

15. The gas delivery assembly of claim 1, wherein the bottom surface comprises a tapered surface.

16. The gas delivery assembly of claim 15, wherein the tapered bottom surface of the covering member comprises a surface selected from the group consisting of a straight surface, a concave surface, a convex surface, or combinations thereof.

17. The gas delivery assembly of claim 15, wherein the tapered bottom surface of the covering member is shaped as a funnel.

18. The gas delivery assembly of claim 1, wherein the bottom surface is substantially flat.

19. The gas delivery assembly of claim 1, further comprising one or more gas

sources coupled to each gas conduit.

20. The gas delivery assembly of claim 19, wherein a common purge gas source is coupled to each gas conduit.

21. The gas delivery assembly of claim 19, wherein separate reactant gas sources are coupled to each gas conduit.

22. The gas delivery assembly of claim 19, wherein a common purge gas source is coupled to each gas conduit and wherein separate reactant gas sources are coupled to each gas conduit.

23. A chamber, comprising:

a substrate support having a substrate receiving surface;

a chamber lid comprising a passageway at a central portion of the chamber lid and a tapered bottom surface extending from the passageway to a peripheral portion of the chamber lid, the tapered bottom surface shaped and sized to substantially cover the substrate receiving surface;

one or more valves coupled to the passageway; and

one or more gas sources coupled to each valve.

24. The chamber of claim 23, wherein the tapered bottom surface of the chamber lid comprises a surface selected from the group consisting of a straight surface, a concave surface, a convex surface, or combinations thereof.

25. The chamber of claim 23, wherein the tapered bottom surface of the chamber lid is shaped as a funnel.

26. The chamber of claim 23, further comprising a choke disposed on the chamber lid adjacent a perimeter of the tapered bottom surface.

27. The chamber of claim 26, wherein the choke has an inner diameter at least as

long as a diameter of the substrate receiving surface.

28. The chamber of claim 23, wherein the passageway comprises an expanding channel.

29. The chamber of claim 23, further comprising one or more gas conduits coupling the one or more valves to the passageway.

30. The chamber of claim 23, wherein a plurality of flow sections are defined between the tapered bottom surface of the chamber lid and the substrate receiving surface define, wherein a ratio of a maximum area of the flow sections to a minimum area of the flow sections is less than about 2.0.

31. The chamber of claim 30, wherein the ratio of the maximum area of the flow sections to the minimum area of the flow sections is less than about 1.5.

32. The chamber of claim 30, wherein the ratio of the maximum area of the flow sections to the minimum area of the flow sections is less than about 1.3.

33. The chamber of claim 30, wherein the ratio of the maximum area of the flow sections to the minimum area of the flow sections is about 1.0.

34. A chamber, comprising:

a substrate support having a substrate receiving surface;

a chamber lid comprising a passageway at a central portion of the chamber lid and comprising a bottom surface extending from the passageway to a peripheral portion of the chamber lid, the bottom surface shaped and sized to substantially cover the substrate receiving surface;

one or more valves coupled to the passageway;

one or more gas sources coupled to each valve; and

a reaction zone defined between the chamber lid and the substrate receiving surface, the reaction zone comprising a small volume.

35. The chamber of claim 34, wherein the small volume comprises about 1,000 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 200 mm diameter substrate.

36. The chamber of claim 34, wherein the small volume comprises about 500 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 200 mm diameter substrate.

37. The chamber of claim 34, wherein the small volume comprises about 200 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 200 mm diameter substrate.

38. The chamber of claim 34, wherein the small volume comprises about 3,000 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 300 mm diameter substrate.

39. The chamber of claim 34, wherein the small volume comprises about 1,500 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 300 mm diameter substrate.

40. The chamber of claim 34, wherein the small volume comprises about 600 cm^3 or less and wherein the substrate receiving surface is adapted to receive a 300 mm diameter substrate.

41. The chamber of claim 34, further comprising a choke disposed on the chamber lid adjacent a perimeter of the bottom surface.

42. The chamber of claim 41, wherein the choke has an inner diameter at least as long as a diameter of the substrate receiving surface.

43. The chamber of claim 34, wherein the passageway comprises an expanding

channel.

44. The chamber of claim 34, further comprising one or more gas conduits coupling the one or more valves to the passageway.

45. A chamber, comprising:

a substrate support having a substrate receiving surface;

a chamber lid comprising a tapered expanding channel extending from a central portion of the chamber lid and a bottom surface extending from the expanding channel to a peripheral portion of the chamber lid, the bottom surface shaped and sized to substantially cover the substrate receiving surface;

one or more valves coupled to the gradually expanding channel; and

one or more gas sources coupled to each valve.

46. The chamber of claim 45, further comprising one or more gas conduits coupling the one or more valves to the expanding channel, the one or more gas conduits having an inner diameter which increases toward the expanding channel.

47. The chamber of claim 46, wherein the one or more gas conduits have a tapered inner diameter which increases toward the expanding channel.

48. The chamber of claim 46, wherein each gas conduit comprises a plurality of sections have a progressively larger inner diameter toward the expanding channel.

49. The chamber of claim 45, wherein the tapered expanding channel comprises a surface selected from the group consisting of a straight surface, a concave surface, a convex surface, or combinations thereof.

50. The chamber of claim 45, wherein the tapered expanding channel is shaped as a truncated cone.

51. The chamber of claim 45, wherein the tapered expanding channel comprises an

upper portion and a lower portion, the upper portion having a smaller inner diameter than the lower portion.

52. The chamber of claim 45, further comprising one or more gas conduits coupling the one or more valves to the expanding channel.

53. The chamber of claim 52, wherein the one or more gas conduits are disposed normal to a longitudinal axis of the expanding channel.

54. The chamber of claim 52, wherein the one or more gas conduits are disposed at an angle to a longitudinal axis of the expanding channel.

55. The chamber of claim 54, wherein the one or more gas conduits are angled downwardly.

56. The chamber of claim 54, wherein the one or more gas conduits are angled upwardly.

57. The chamber of claim 52, wherein the one or more gas conduits are disposed along the length of the expanding channel.

58. The chamber of claim 53, wherein the one or more gas conduits are disposed at the same length around the expanding channel.

59. The chamber of claim 58, wherein the one or more gas conduits are equally spaced out around a perimeter the expanding channel.

60. The chamber of claim 58, wherein the one or more gas conduits are disposed at an upper portion of the expanding channel.

61. The chamber of claim 52, wherein the one or more gas conduits are positioned toward same circular direction.

62. The chamber of claim 52, wherein the one or more gas conduits are positioned at an angle from a center of the expanding channel.

63. A chamber, comprising:

a substrate support having a substrate receiving surface;

a chamber lid comprising an expanding channel extending from a central portion of the chamber lid and comprising a tapered bottom surface extending from the expanding channel to a peripheral portion of the chamber lid;

one or more gas conduits disposed around an upper portion of the expanding channel, wherein the one or more gas conduits are disposed at an angle from a center of the expanding channel; and

a choke disposed on the chamber lid adjacent a perimeter of the tapered bottom surface.

64. The chamber of claim 63, wherein the one or more gas conduits are disposed normal to a longitudinal axis of the expanding channel.

65. The chamber of claim 63, wherein the one or more gas conduits are disposed at an angle to a longitudinal axis of the expanding channel.

66. The chamber of claim 65, wherein the one or more gas conduits are angled downwardly.

67. The chamber of claim 65, wherein the one or more gas conduits are angled upwardly.

68. The chamber of claim 63, wherein one or more valves are coupled to each gas conduit.

69. The chamber of claim 68, wherein the one or more valves are selected from the group consisting of pneumatically actuated valves and electrically actuated valves.

70. The chamber of claim 68, wherein the one or more valves are zero dead volume valves.

71. The chamber of claim 68, further comprising one or more gas sources coupled to each valve.

72. The chamber of claim 68, wherein a common purge gas source is coupled to each valve.

73. The chamber of claim 68, wherein separate reactant gas sources are coupled to each valve.

74. The chamber of claim 68, wherein a common purge gas source is coupled to each valve and wherein separate reactant gas sources are coupled to each valve.

75. A gas delivery assembly, comprising:

a first valve comprising:

a first delivery line having a first reactant gas inlet, a first reactant gas outlet, and a first valve seat assembly; and

a first purge line having a first purge gas inlet and a first purge gas outlet, the first purge gas outlet in communication with the first delivery line downstream of the first valve seat assembly; and

a second valve comprising:

a second delivery line having a second reactant gas inlet, a second reactant gas outlet, and a second valve seat assembly;

a second purge line having a second purge gas inlet and a second purge gas outlet, the second purge gas outlet in communication with the second delivery line downstream of the second valve seat assembly.

76. The gas delivery assembly of claim 75, further comprising a common purge gas source in communication with the first purge gas inlet and the second purge gas inlet.

77. The gas delivery assembly of claim 75, further comprising a first reactant gas source in communication with the first react gas inlet.

78. The gas delivery assembly of claim 75, further comprising a second reactant gas source in communication with the second reactant gas inlet.

79. The gas delivery assembly of claim 77, wherein the first reactant gas source comprises a first reactant and a carrier gas.

80. The gas delivery assembly of claim 78, wherein the second reactant gas source comprises a second reactant and a carrier gas.

81. A method of depositing a material layer over a substrate structure, comprising:

delivering a first reactant gas and a first purge gas through a first gas conduit, wherein the first reactant gas is provided in pulses and the first purge gas is provided in a continuous flow; and

delivering a second reactant gas and a second purge through a second gas conduit; wherein the second reactant gas is provided in pulses and the second purge gas is provided in a continuous flow.

82. The method of claim 81, wherein the pulses of the first reactant gas and the pulses of the second reactant gas are alternating.

83. The method of claim 82, further comprising a time period between the pulses of the first reactant gas and the second reactant gas.

84. The method of claim 81, wherein the first reactant gas comprises a first reactant and a carrier gas.

85. The method of claim 81, wherein the second reactant gas comprises a second reactant and a carrier gas.

86. The method of claim 81, wherein the first purge gas and the second purge gas are supplied by a common purge gas source.

87. The method of claim 81, wherein the first reactant comprises a tantalum containing compound and wherein the second reactant comprises a nitrogen containing compound.

88. The method of claim 87, wherein the nitrogen containing compound comprises ammonia.

89. The method of claim 87, wherein the tantalum containing compound comprises PDMAT.

90. The method of claim 82, wherein each pulse is for a time period of about 0.5 second or less.

91. The method of claim 82, wherein a time duration between each pulse is for a time period of about 0.5 second or less.

92. A method of delivering gases to a substrate in a substrate processing chamber, comprising:

providing one or more gases into the substrate processing chamber;

reducing a velocity of the gases through non-adiabatic expansion;

providing the gases to a central portion of the substrate; and

directing the gases radially across the substrate from the central portion of the substrate to a peripheral portion of the substrate.

93. The method of claim 92, wherein providing one or more gases into the chamber comprises directing the gases in an initial circular direction over a central portion of the substrate.

94. The method of claim 93, wherein providing the gases to the central portion of the substrate comprises providing the gases in a downwardly flow.

95. The method of claim 92, wherein the gases are directed radially across the substrate from the central portion of the substrate to a peripheral portion of the substrate at a substantially uniform velocity.

96. The method of claim 95, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 2.0 or less.

97. The method of claim 95, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 1.5 or less.

98. The method of claim 95, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 1.3 or less.

99. A method of delivering gases to a substrate in a substrate processing chamber, comprising:

providing one or more gases to a central portion of the substrate; and

directing the gases radially at a substantially uniform velocity across the substrate from the central portion of the substrate to a peripheral portion of the substrate.

100. The method of claim 99, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 2.0 or less.

101. The method of claim 99, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 1.5 or less.

102. The method of claim 99, wherein a substantially uniform velocity comprises a ratio of a maximum velocity over a minimum velocity of about 1.3 or less.

103. A method of delivering gases to a substrate in a substrate processing chamber, comprising:

providing one or more gases into the substrate processing chamber in a circular flow path at a first velocity;

providing the gases toward a central portion of the substrate in a downwardly flow path at a second velocity, wherein the second velocity is less than the first velocity; and

providing the gases across the substrate in a radial flow path at a substantially uniform velocity across the substrate.

104. The method of claim 103, further comprising providing the gases from the edge of the substrate in a radial direction at a third velocity, wherein the third velocity is greater than the substantially uniform velocity.

105. The method of claim 103, wherein the circular flow path comprises a vortex flow path.